develop vaccines pre-emptively, says Farrar. No vaccine was available when the Ebola outbreak started, but researchers developed a safe and effective vaccine against the Zaire strain responsible in record time — just a year and a half. Making a vaccine from scratch usually takes years, sometimes even decades.

In this case, scientists were able to move fast because US and Canadian researchers had already developed experimental Ebola vaccines. But they lost valuable time because the formulations, which had sat on the shelf for years, had not yet been tested in humans.

"We had to spend what was 9–12 months getting safety data for those vaccines, and that was 9–12 months where ultimately many people lost their lives," says Farrar.

By contrast, CEPI's planned work on MERS, Nipah and Lassa will take experimental vaccine candidates — two for each disease — through the testing stage in humans to establish that they are safe and produce an immune response that is likely to be protective (see 'Vaccine pipelines'). It would then create sufficient stockpiles of promising candidates to test rapidly for efficacy, and possible use, in the event of an outbreak. CEPI aims to have stockpiles for the three diseases by 2021.

MARKET FAILURE

CEPI intends to support research at every stage, from basic lab work to vaccine discovery and clinical trials. It also made its first call for research proposals on 18 January, and teams have until 8 March to submit preliminary proposals for grants.

"For too long, we have separated out the academic work from the next step of taking it into all that is actually required to make a vaccine," says Farrar. And there is no market for vaccines against 'potential' epidemic threats, he notes, which explains the lack of commercial incentive to take research leads out of the lab and into clinical development.

CEPI aims to change this state of affairs by bringing together sustained long-term funding from governments and philanthropies to encourage collaboration with biotechnology companies and large vaccine makers.

Industry involvement will be crucial, says Farrar. GlaxoSmithKline, Johnson & Johnson, Sanofi, Pfizer, Takeda and several other pharmaceutical companies have said that they will support the initiative, but details about their involvement are still under negotiation.

CEPI is particularly keen for the United States to join, but discussions will take time given the change in administration, adds Røttingen. "Irrespective of the government, it was a bad time to engage the United States on that." ■ SEE EDITORIAL P.436

DESOUZA/FRITSCHI/SHAFIEKHANI/SUHAS/UNIV. MISSOURI

A robot measures the crops in an agricultural field near Columbia, Missouri.

TECHNOLOGY

Robots stop to smell the flowers

Plant biology is getting a high-tech upgrade that will enable researchers to collect data faster and in more detail.

BY HEIDI LEDFORD

As a postdoc, plant biologist Christopher Topp was not satisfied with the usual way of studying root development: growing plants on agar dishes and placing them on flatbed scanners to measure root lengths and angles. Instead, he would periodically stuff his car with plants in pots dripping with water and drive more than 600 kilometres from North Carolina to Georgia to image his specimens in 3D, using an X-ray machine in a physics lab.

Five years later, the idea of using detailed imaging to study plant form and function has caught on. The use of drones and robots is also on the rise as researchers pursue the 'quantified plant' — one in which each trait has been carefully and precisely measured from nearly every angle, from the length of its root hairs to the volatile chemicals it emits under duress. Such traits are known as an organism's phenotype, and researchers are looking for faster and more comprehensive ways of characterizing it.

From 10 to 14 February, scientists will gather in Tucson, Arizona, to compare their methods. Some will describe drones that buzz over research plots armed with hi-tech cameras; others will discuss robots that lumber through fields bearing equipment to log each plant's growth.

The hope is that such efforts will speed up plant breeding and basic research, uncovering new aspects of plant physiology that can determine whether a plant will thrive in the field. "Phenotype is infinite," says Topp, who now works at the Donald Danforth Plant Science Center in St Louis, Missouri. "The best we can do is capture an aspect of it — and we want to capture the most comprehensive aspect we can."

The plummeting cost of DNA sequencing has made it much easier to find genes, but working out what they do remains a challenge, says plant biologist Ulrich Schurr of the Jülich Research Centre in Germany. "It is very easy now to sequence a lot of stuff," he says. "But what was not developed with the same kind of speed was the analysis of the structure and function of plants."

Plant breeders are also looking beyond ▶

the traits they used to focus on — such as yield and plant height — for faster ways to improve crops. "Those traits are useful but not enough," says Gustavo Lobos, an ecophysiologist at the University of Talca in Chile. "To cope with what is happening with climate change and food security, some breeders want to be more efficient." Researchers aiming to boost drought tolerance, for example, might look at detailed features of a plant's root system, or at the arrangement of its leaves.

A NEED FOR SPEED

The needs of these researchers have bred an expanding crop of phenotyping facilities and projects. In 2015, the US Department of Energy announced a US$34-million project to generate the robotics, sensors and methods needed to characterize sorghum, a biofuel crop. Last year, the European Union launched a project to create a pan-European network of phenotyping facilities. And academic networks have sprung up around the globe as plant researchers attempt to standardize approaches and data analyses.

Large-scale phenotyping has long been used in industry, but was too expensive for academic researchers, says Fiona Goggin, who studies plant–insect interactions at the University of Arkansas in Fayetteville. Now, the falling prices of cameras and drones, as well as the rise of the 'maker' movement that focuses on home-made apparatus, are enticing more academics to enter the field, she says.

At Washington State University in Pullman, biological engineer Sindhuja Sankaran's lab is preparing to deploy drones carrying lidar, the laser equivalent of radar. The system will scan agricultural fields to gather data on plant height and the density of leaves and branches. Sankaran also uses sensors to measure the volatile chemicals that plants give off, particularly when they are under attack from insects or disease. She hopes eventually to mount the sensors on robots.

Sankaran's mechanical minions return from their field season with hundreds of gigabytes of raw data, and analysing the results keeps her team glued to computers for the better part of a year, she says. Many researchers do not realize the effort and computing savvy it takes to pick through piles of such data, says Edgar Spalding, a plant biologist at the University of Wisconsin–Madison. "The phenotyping community has rushed off to collect data and the computing is an afterthought."

Standardizing the technology is another barrier, says Nathan Springer, a geneticist at the University of Minnesota in St Paul. The lack of equipment everyone can use means that some researchers have to rely on slower data-collection methods. Springer has been working with 45 research groups to characterize 1,000 varieties of maize (corn) grown in 20 different environments across the United States and Canada. The project has relied heavily on hand measurements rather than on drones and robots, he says.

Topp now has his own machine to collect computed tomography (CT) images, but processing samples is still a little slow for his liking. He speaks with reverence of a facility at the University of Nottingham, UK, that speeds up its scans by using robots to feed the plants through the CT machine. But he's pleased that he no longer has to haul his soggy cargo across three states to take measurements. "It's just endless, the number of possibilities." ■

PUBLISHING

'Is my review confidential?'

Open-science advocate says journals should be clearer to peer-reviewers about terms and conditions.

BY QUIRIN SCHIERMEIER

Are peer-reviewers free to openly share the content of their reviews if journal editors haven't explicitly told them not to? Jon Tennant, a scientist-turned-outreach specialist, thinks so.

In 2016, Tennant reviewed a research paper submitted to the journal *Palaeogeography, Palaeoclimatology, Palaeoecology*. He recommended that the authors' new approach to studying fossil seabird fauna should be published. The journal's editors agreed and published the paper.

Tennant, who now works as communications director at ScienceOpen, an online platform that promotes open-access research, wanted to receive credit for his unpaid peer-review work. With permission from the authors of the paper, he decided to openly post the text of his review on Publons, a platform for sharing reviews.

But his post was turned down. Publons told him that the journal's publisher, Elsevier, requires reviewers to obtain permission from journal editors before posting a review.

That was not part of the deal — at least, not explicitly — Tennant argues. "I didn't sign a confidentiality agreement, and I was not aware that I had implicitly agreed to the journal's policies," he says.

IMPLICIT GUIDELINES

Elsevier does have peer-review guidelines on its website, notes Thomas Algeo, a geochemist at the University of Cincinnati in Ohio and co-editor-in-chief of *Palaeogeography, Palaeoclimatology, Palaeoecology*. According to the guidelines, reviewers "must not share information about the review with anyone without permission from the editors and authors".

> ***"Reviewers should not need to dig around for terms and conditions."***

"These are general community standards for peer review, of which all experienced science professionals should be aware," says Algeo. But Tennant says he was never explicitly pointed to Elsevier's guidelines.

Charles Oppenheim, a consultant in Aberdeen, UK, who specializes in copyright issues and scholarly publishing, thinks Tennant has a point. "Reviewers should not need to dig around for terms and conditions," he says. Scholarly publishers, he adds, shouldn't assume confidentiality; they should make it explicitly clear upfront if their policy is to restrict dissemination of reviews. "If they don't, they are heading for difficulties as the idea of open peer review is becoming more common."

POLICY RETHINK

The growing popularity of open peer review is prompting journals to rethink both their policies and the way in which they communicate these to reviewers, says Andrew Preston, the London-based co-founder and chief executive of Publons. Many journals are making clear on Publons what they do — and don't — allow in terms of sharing reviews, he says.

"We're caught in the middle of people who want very different things," Preston says. "And while the community will need to find middle ground, it's good that some people are pushing at the edges." ■